



Semiconductor Research Corporation



ITRS-Emerging Research Materials

Enabling and Creating Novel Information Processing Technologies

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International Technology Roadmap for Semiconductors



Emerging Research Materials

- ◆ To create frame work to direct materials research for enabling and creating emerging research devices and “Functional Organizations” for the CMOS platform....
 - ❖ The ITRS driven nano-materials research....
 - ❖ Infrastructure for nano-materials by design to discover and innovate novel materials....

ERM-Scope-2004

Applications

- ◆ Emerging Logic and Memory
- ◆ Emerging Functional Organization
- ◆ Emerging Information Processing Technologies

Material by Design Infrastructure

- ◆ Synthesis
- ◆ Modeling and Simulations
- ◆ Characterization/Metrology
- ◆ Surface/Interface Science
- ◆ Emerging Other Needs



Emerging Memory and Logic Devices

- ◆ **Title: Materials Issues of Emerging Memory and Logic Devices**
- ◆ **Goal: Specify materials requirements for each of Memory and Logic entry in ERD tables**
- ◆ **Scope:**
 - ❖ **Materials System**
 - ❖ **Materials Techniques**
 - ❖ **Materials related challenges**
 - **Materials Design Challenges**
 - **Interface & Integration Challenges**



Emerging “Functional Organizations”

- ◆ **Title: Connection between Future Applications Needs and Enabling Nanoscale Materials Capabilities**
- ◆ **Goal: Provide perspective on how functional materials can satisfy the future needs of information processing**
- ◆ **Scope (Work in Progress):**
 - ❖ **Functionalized materials for fabrication and synthesis of larger building blocks**
 - ❖ **Materials and structures that can perform the basic functions of information processing and storage**
 - ❖ **Combinations of materials and structures that will enable new devices with circuit and system functions previously achievable only in multiple individual devices and circuits respectively**



Material Synthesis & Construction

- ◆ **Goal: Identify materials synthesis and construction that could support beyond CMOS device fabrication**
- ◆ **Scope:**
 - ❖ **Support Emerging Memory/Logic and Emerging Functional Organizations**
 - ❖ **Identify high priority material**
 - ❖ **Establish key properties**
 - ❖ **Identify & prioritize promising synthesis & construction techniques**
 - ❖ **Identify M&S and Characterization needs**



Characterization & Metrology

- ◆ **Goal:** To identify critical characterization and metrology tools and methods required to support the research, development, and eventual manufacture of emerging materials and devices.
- ◆ **Scope:** Support characterization and metrology of ERD & ERM that will:
 - ❖ Enable identification and optimization of critical physical and electrical properties (such as nanostructure dimensions & composition, nanoscale electronic density and magnetic properties, static & dynamic device characteristics)
 - ❖ Support extraction of parameters for modeling and simulation of materials synthesis and device properties
 - ❖ Include both organic and inorganic materials
 - ❖ Focus on interfaces and properties at the nanoscale
 - ❖ Eventually include statistical metrology required for production



Modeling and Simulation

- ◆ **Goal: Modeling and Simulation Infrastructure for Materials by Design (Synthesis , Characterization, Surfaces and Interfaces)**



ERM-Tasks and Teams (As of April 18th, 2004)

Applications:

- ◆ Task: Emerging Logic and Memory Devices (2 Tables in 2004)
Team: Zhirnov*, Black, Takagi and Yoo
- ◆ Task: Emerging Nano-Architectures (1 Table in 2004)
Team: Carruthers*, Forshaw, Wang and Waser.
- ◆ Task: Emerging Other Information Processing Devices (List only for 2004)
Team: Carruthers, Manchanda and Hutchby

Material by Design Infrastructure:

- ◆ Task: Synthesis (Start with State of the Art)
Team: Garner*, Black, Mazure
- ◆ Task: Modeling and Simulation (Start with State of the Art)
Team: Demkov*, Sadasivan, Reif, Lundstrom(?)
- ◆ Task: Characterization (Start with State of the Art)
Team: Vogel*, Muller, Herr and Garner
- ◆ Task: Surface and Interfaces (White Paper)
Team: Carruthers, Demkov and Sadasivan

*Tasks Conveners

